# Convection Initiation – Nowcasting by data fusion and its Verification

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**ECSS 2011 - 6th European Conference on Severe Storms**
**Palma de Mallorca, Spain, 3-7 October 2011**

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# Outline

Motivation & general idea

Cb-TRAM (**C**umulonim**b**us **TR**acking **A**nd **M**onitoring)

CI-Verification

Additional data sources

# Motivation

Aviation purposes

Cb-TRAM as basic tool

Adding non-satellite fields for further development

# General idea

Basic Tool
(Cb-TRAM)

Verification

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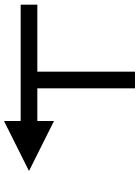
Basic Tool
(Cb-TRAM)

Verification

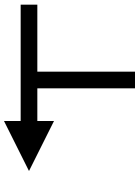


Data Fusion

# General idea

Basic Tool
(Cb-TRAM)

Verification

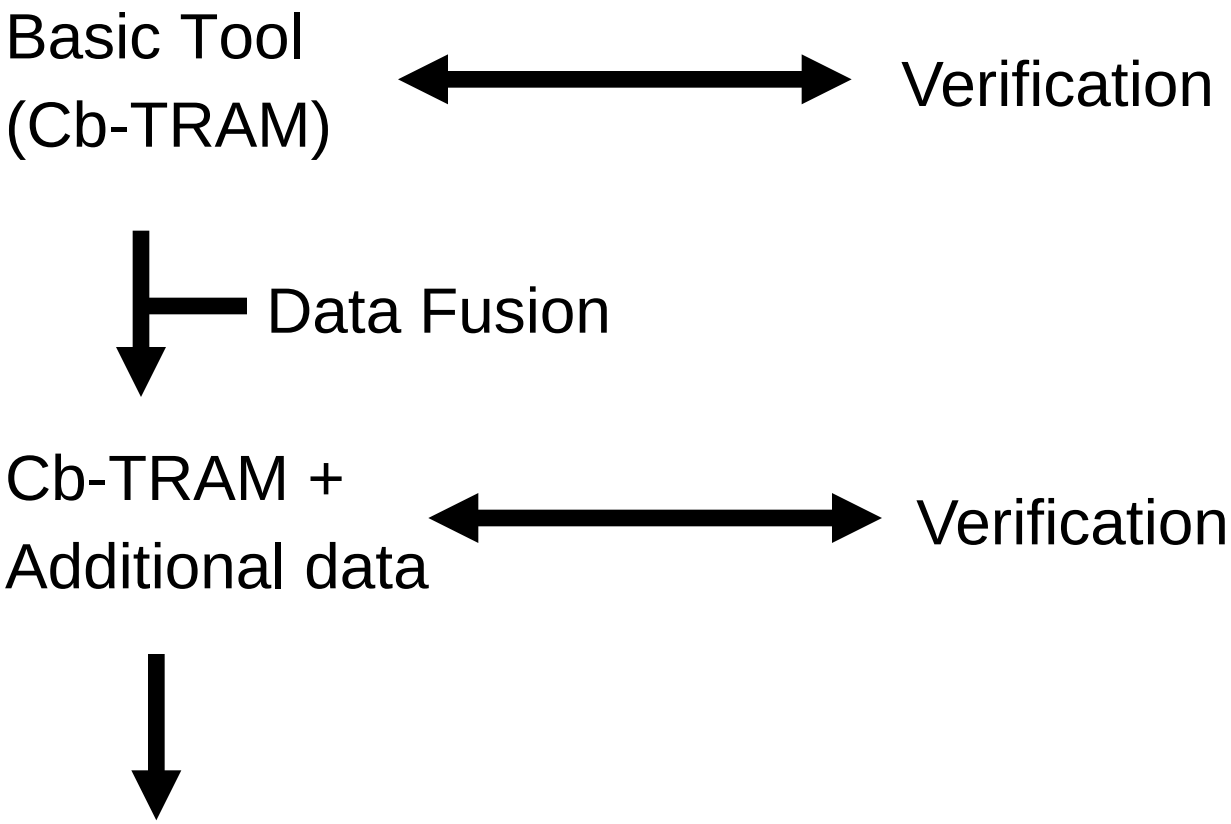


Data Fusion

Cb-TRAM +
Additional data

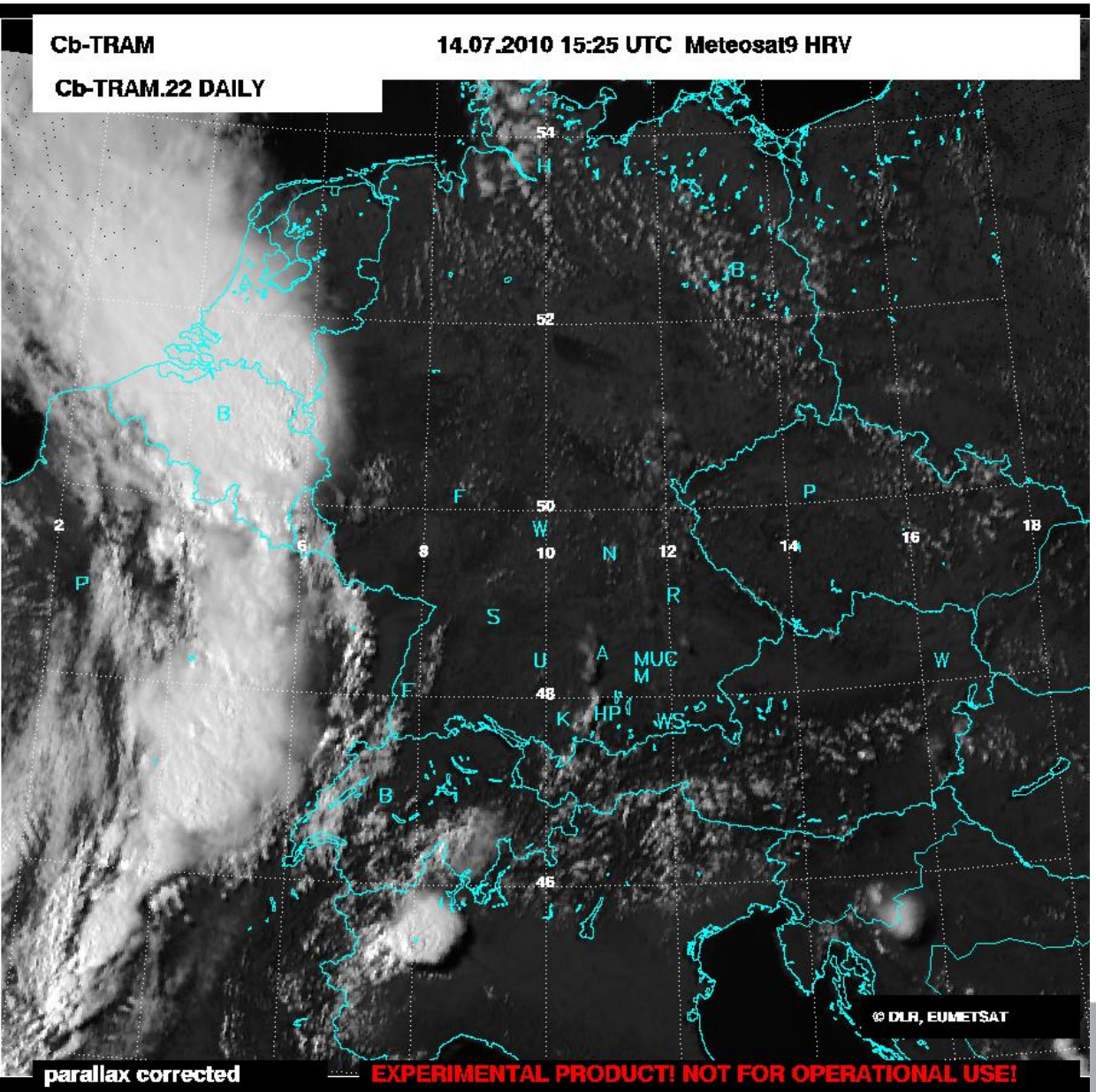
Verification

# General idea

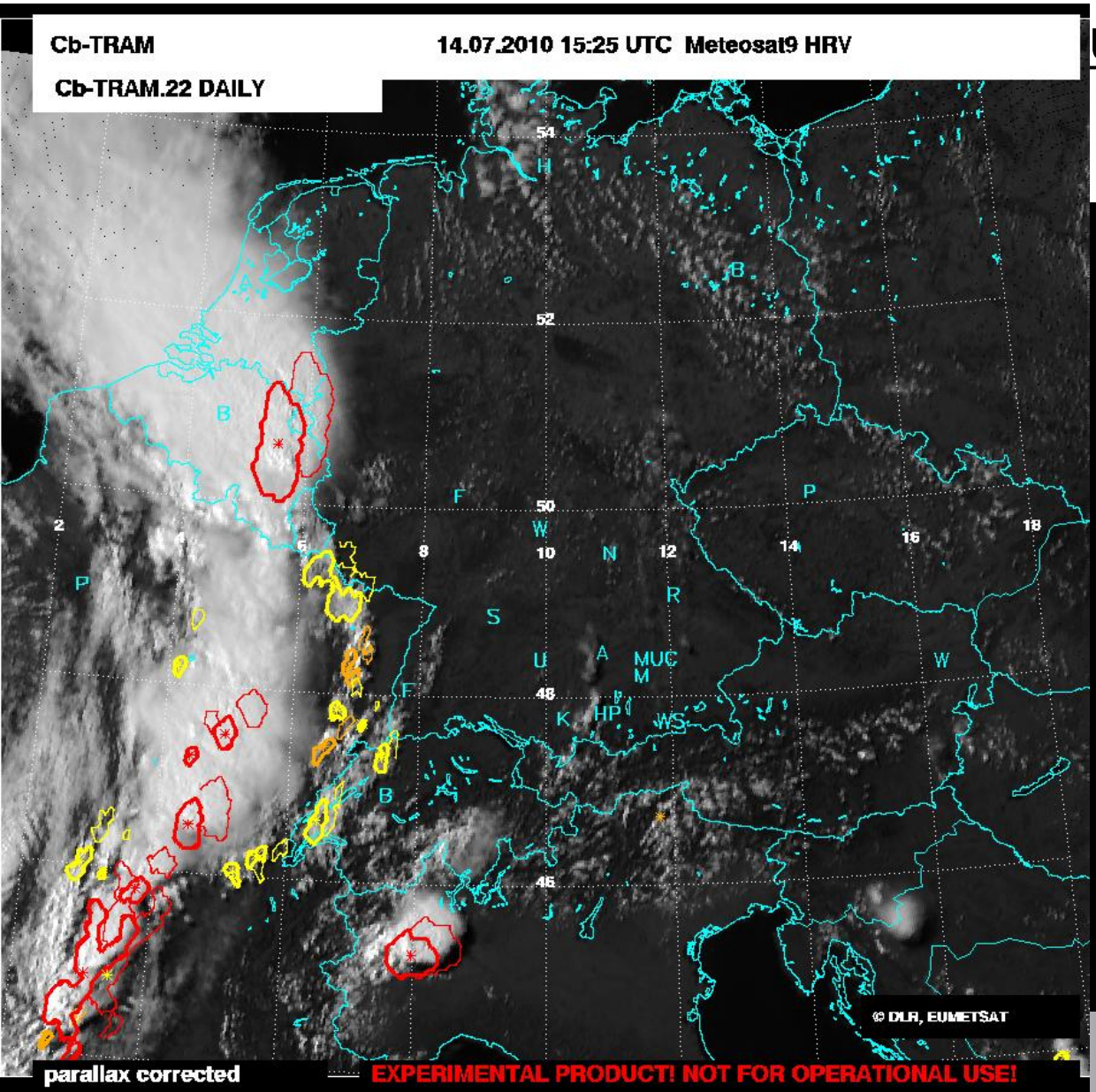



CI-NOW – a CI detection and nowcasting tool

# Cb-TRAM - Cumulonimbus TRacking And Monitoring



# Cb-TRAM - Cumulonimbus TRacking And Monitoring




Used MSG (rapidscan) data:

| | |
|---|---|
| WV 6.2 | IR 10.8 |
| IR 12.0 | HRV |

Detection stages:

1: Convection Initiation (CI)
- development in HRV
- IR 10.8 cooling

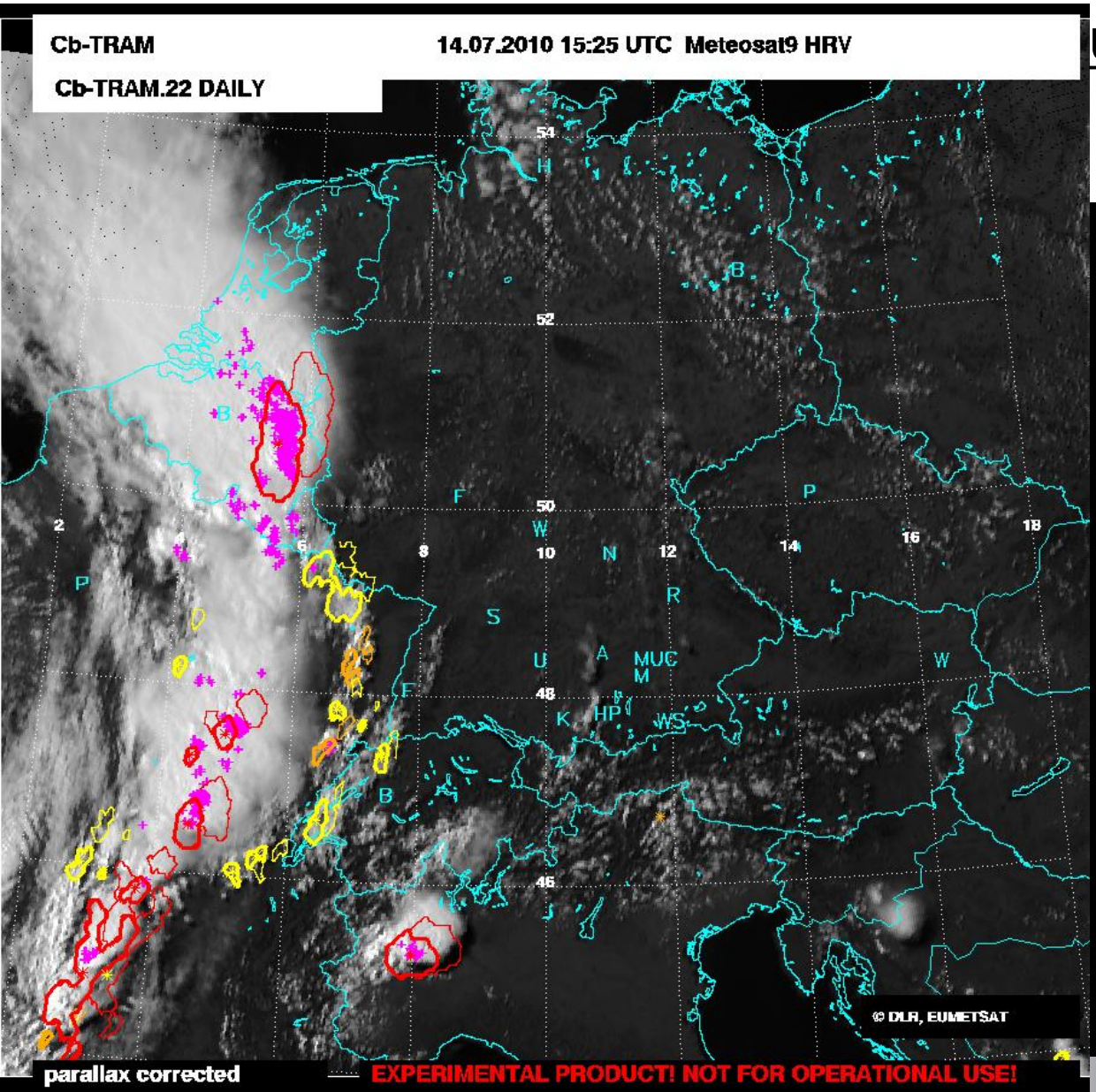
2: Rapid development
- WV 6.2 rapid cooling (> 1K/15min)

3: Mature storms
- T 6.2 - T 10.8
- HRV texture

Extrapolation up to 60 min
(here 30 minute nowcast plotted)

Description: Zinner et al., 2008

# Cb-TRAM - Cumulonimbus TRacking And Monitoring

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- HRV texture

Lightning (LINET)

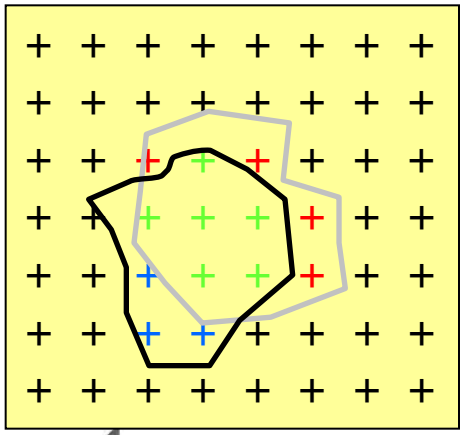
Extrapolation up to 60 min
(here 30 minute nowcast plotted)

Description: Zinner et al., 2008

# CI-Verification

| Contingency table | | Observed | |
|---|---|---|---|
| | | yes | no |
| Forecast | yes | hit | false alarm |
| | no | miss | correct negative |

Cb-TRAM analysis used for comparison with the 15, 30, 45, and 60 minutes CI-stage nowcasts



Pixel based

Requires perfect matching!

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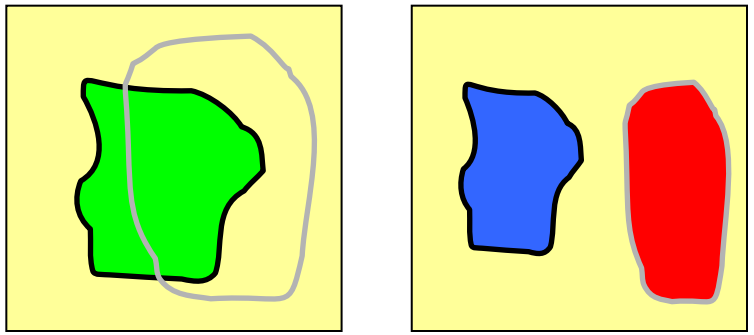
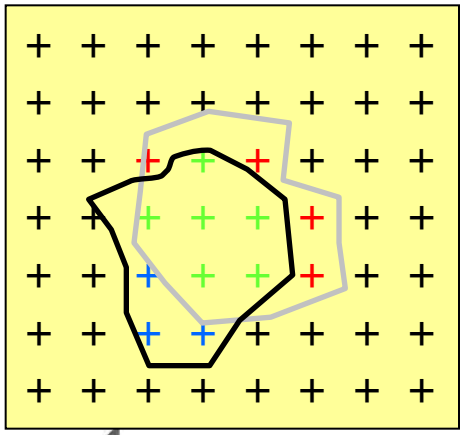
## Object based



double penalty problem



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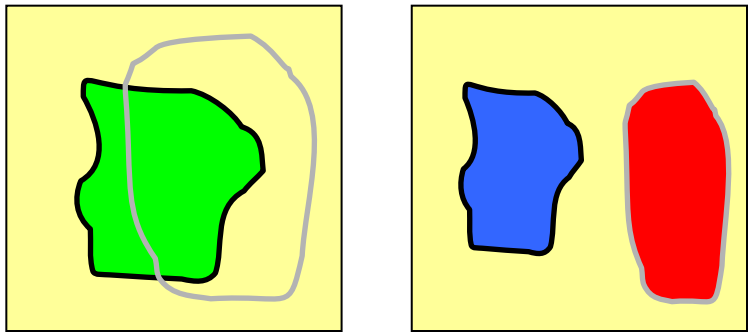

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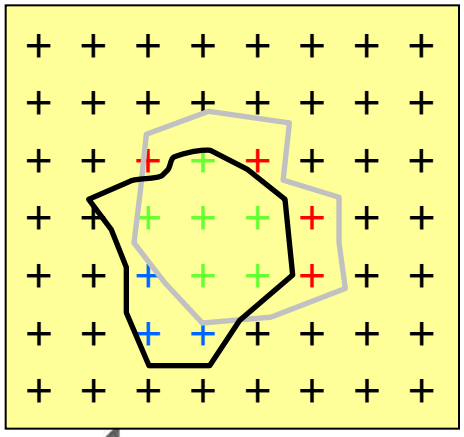
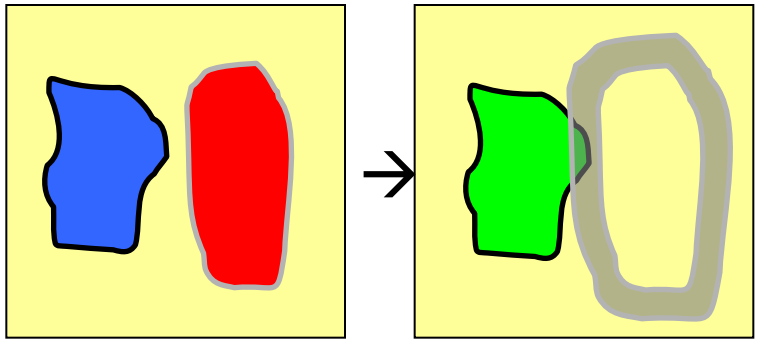


## Pixel based

Requires perfect matching!

## Fuzzy + Object based



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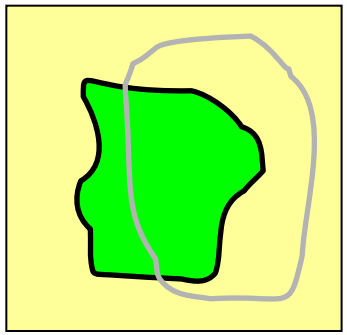
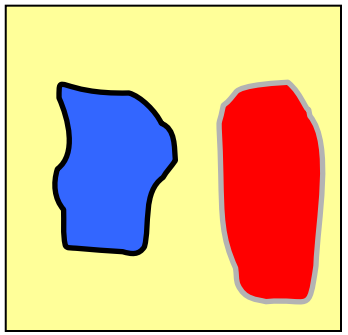




# CI-Verification

Different versions shown:

## Object based
with Cb stage 1 analysis objects for the nowcast overlap

## Developing Object based
without Cb stage 1 analysis objects for the nowcast overlap
→ just developing cells

| Results for the summer 2009, 15 May to 31 August | | | |
|---|---|---|---|
| | 15 min | 30 min | acc 15-60 min |
| Object based POD | 0,5919 | 0,4212 | 0,4093 |
| Object based FAR | 0,6109 | 0,7545 | 0,5448 |
| | | | |
| Dev Object POD | 0,2281 | 0,1992 | 0,1697 |
| Dev Object FAR | 0,8853 | 0,8841 | 0,8176 |

POD = hits / (hits + misses)

FAR = false alarms / (hits + false alarms)
CSI = hits / (hits + misses + false alarms)

# Additional data sources

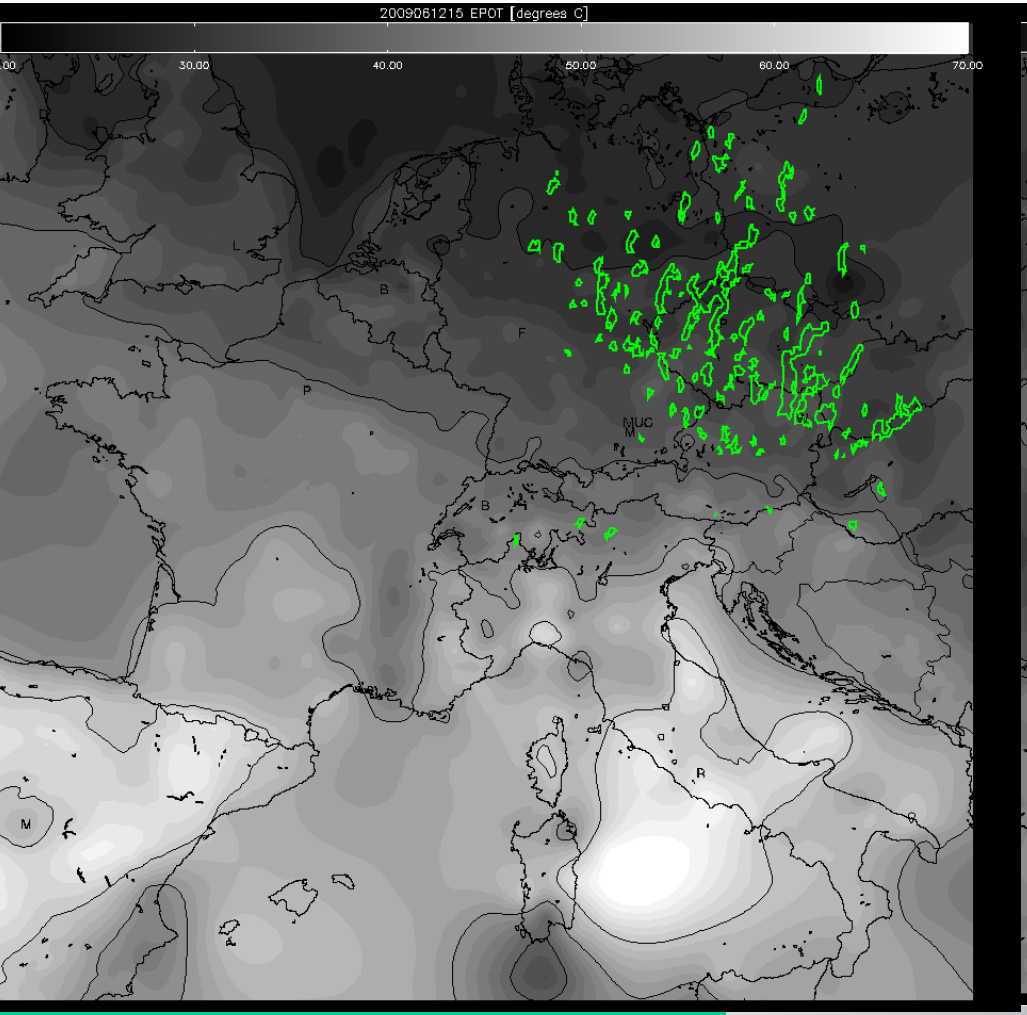
Testing the additional information provided by:

- more satellite channels (SATCAST IFs)
- VERA data (e.g. MFC, equivalent potential temperature)
- COSMO-EU data (e.g. updraft, an instability measure)
- COSMO-DE data (e.g. thunderstorm probability)
- LINET data

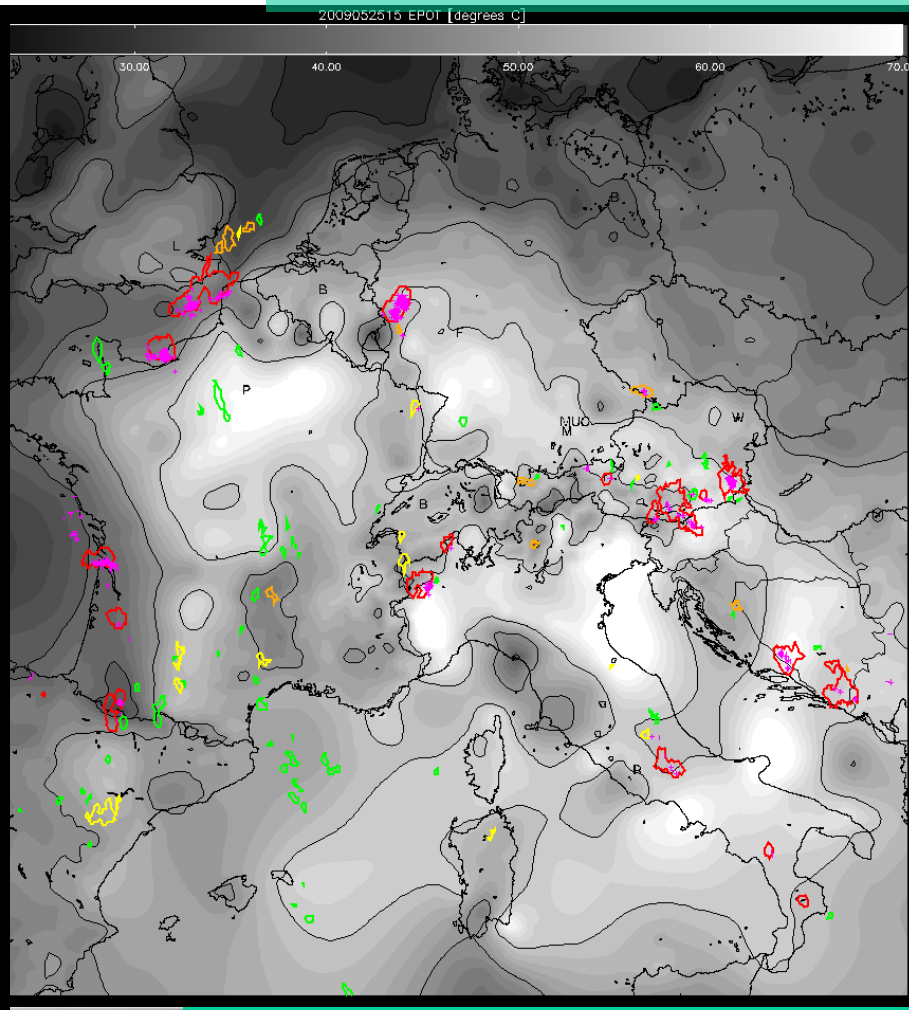
# V ienna E nhanced R esolution A nalysis

More information and references:

www.univie.ac.at/amk/vera/

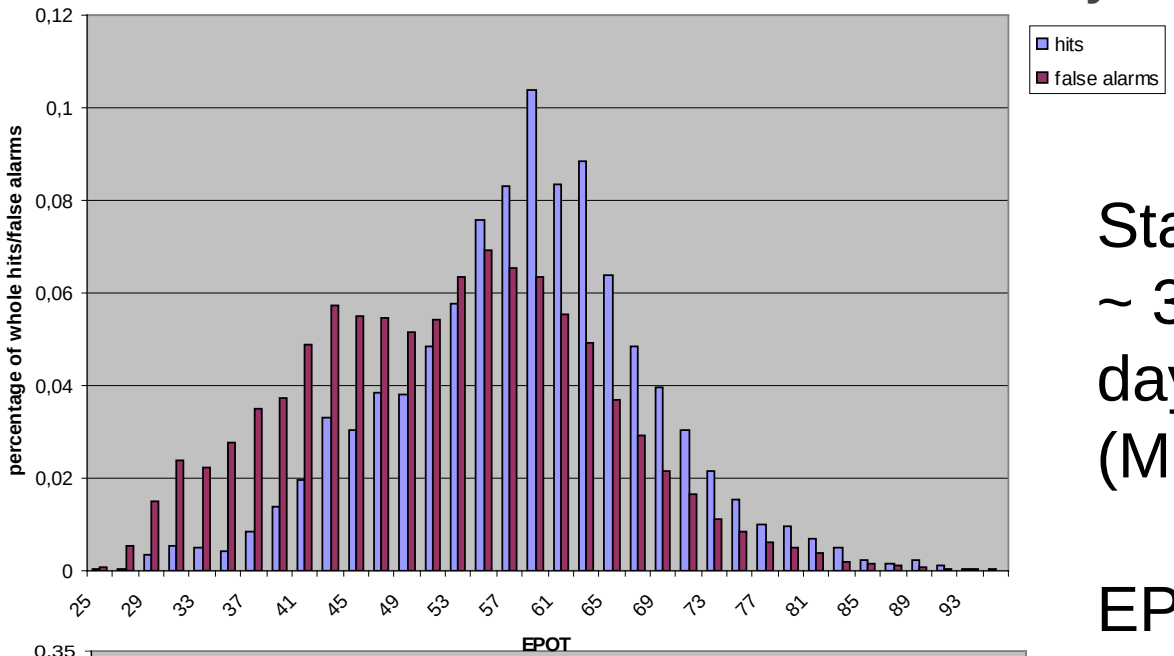


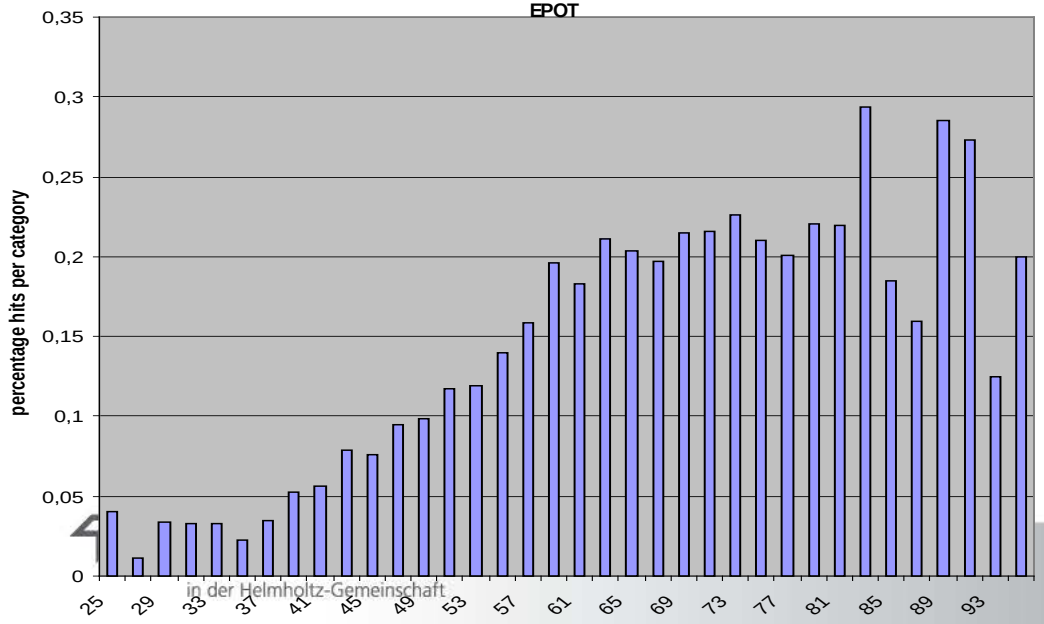

EPOT June 12 2009 15 UTC




EPOT May 25 2009 15 UTC

# V ienna E nhanced R esolution A nalysis

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Statistics calculated for ~ 35.000 CI cells over 87 days in summer 2009 (May 15 - 31 August)

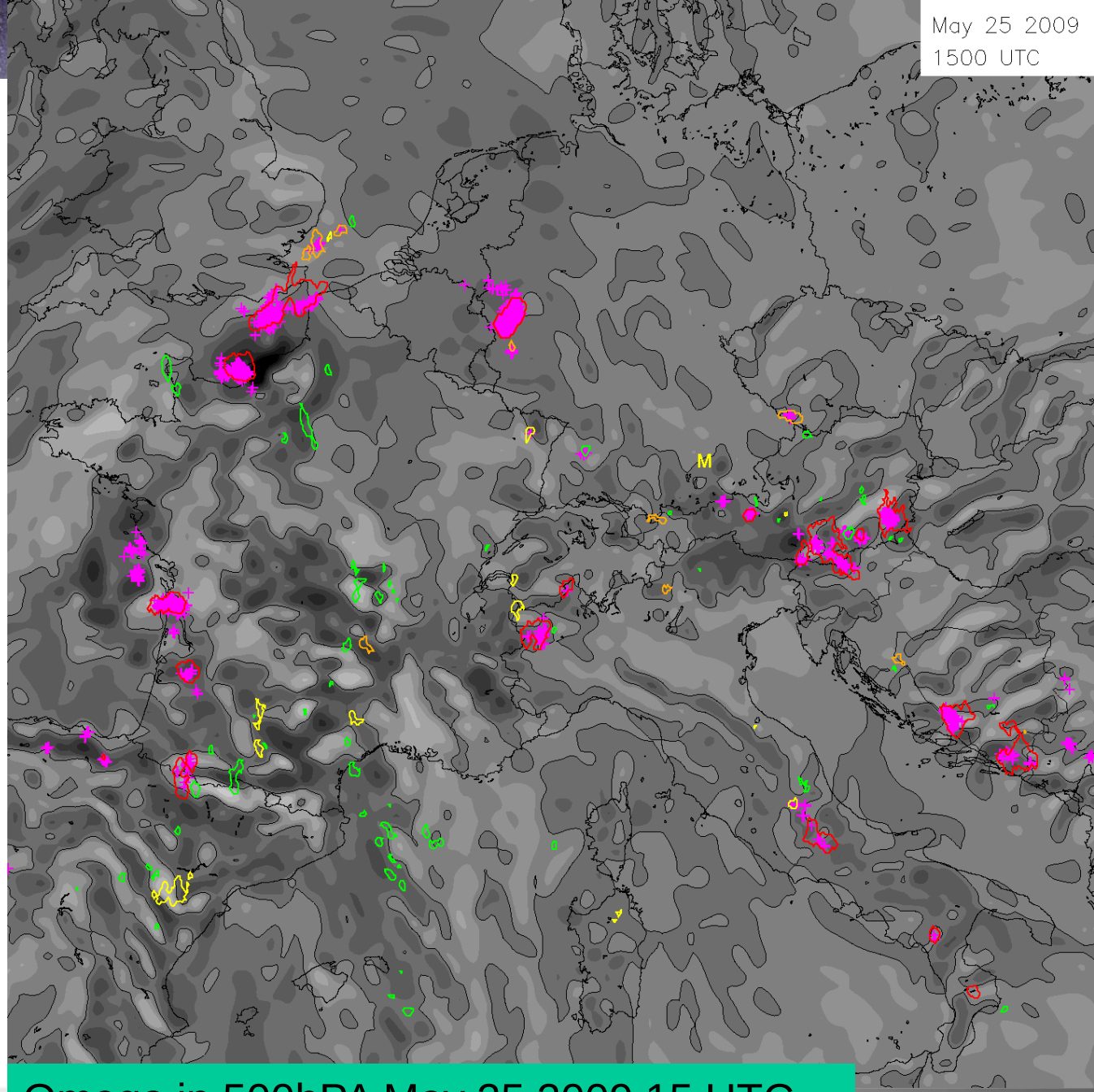
EPOT < 36 °:
2.2 % of all hits
11.2 % of all false alarms

EPOT < 41 °:
6.1 % of all hits
21.6 % of all false alarms

# COSMO-EU

Omega in 500 hPa:

Dark shading represents updraft areas, light shading downdraft areas




Omega in 500hPA May 25 2009 15 UTC

# VERA & COSMO_EU

First Results for Combinations:

Percentage of CI cells filtered with the additional data sources

| | 36° < Epot < 41° | false alarms | hits |
|---|---|---|---|
| Epot < 36° | | 11.2 % | 2.2 % |
| Epot < 36° | MFD > 0 | 16.0 % | 3.5 % |
| Epot < 36° | $\omega_{500} > 6$ | 14.5 % | 3.0 % |
| Epot < 36° | $\omega_{400\text{-}600} > 0$ | 14.0 % | 3.0 % |
| Epot < 36° | $\omega_{500} > 0$ & MFD > 0 | 13.7 % | 2.9 % |
| Epot < 36° | $\omega_{400\text{-}600} > 0$ & MFD > 0 | 12.5 % | 2.5 % |

[MFD] = 10^-4 g/(kg s) & [ω] = hPa/h

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Testing the additional information provided by:

- more satellite channels (SATCAST IFs)
- VERA data (e.g. MFC, equivalent potential temperature)
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NEXT STEPS:

- COSMO-DE data (e.g. thunderstorm probability)
- LINET data

Data fusion (e.g. fuzzy logic)

Verify the abilities for the different products and their fusion

# Thank you for your attention! Questions?

contact: dennis.stich@dlr.de